OIPE
FEB 2 3 2004
PATENT & TRADEMARK OFFICE

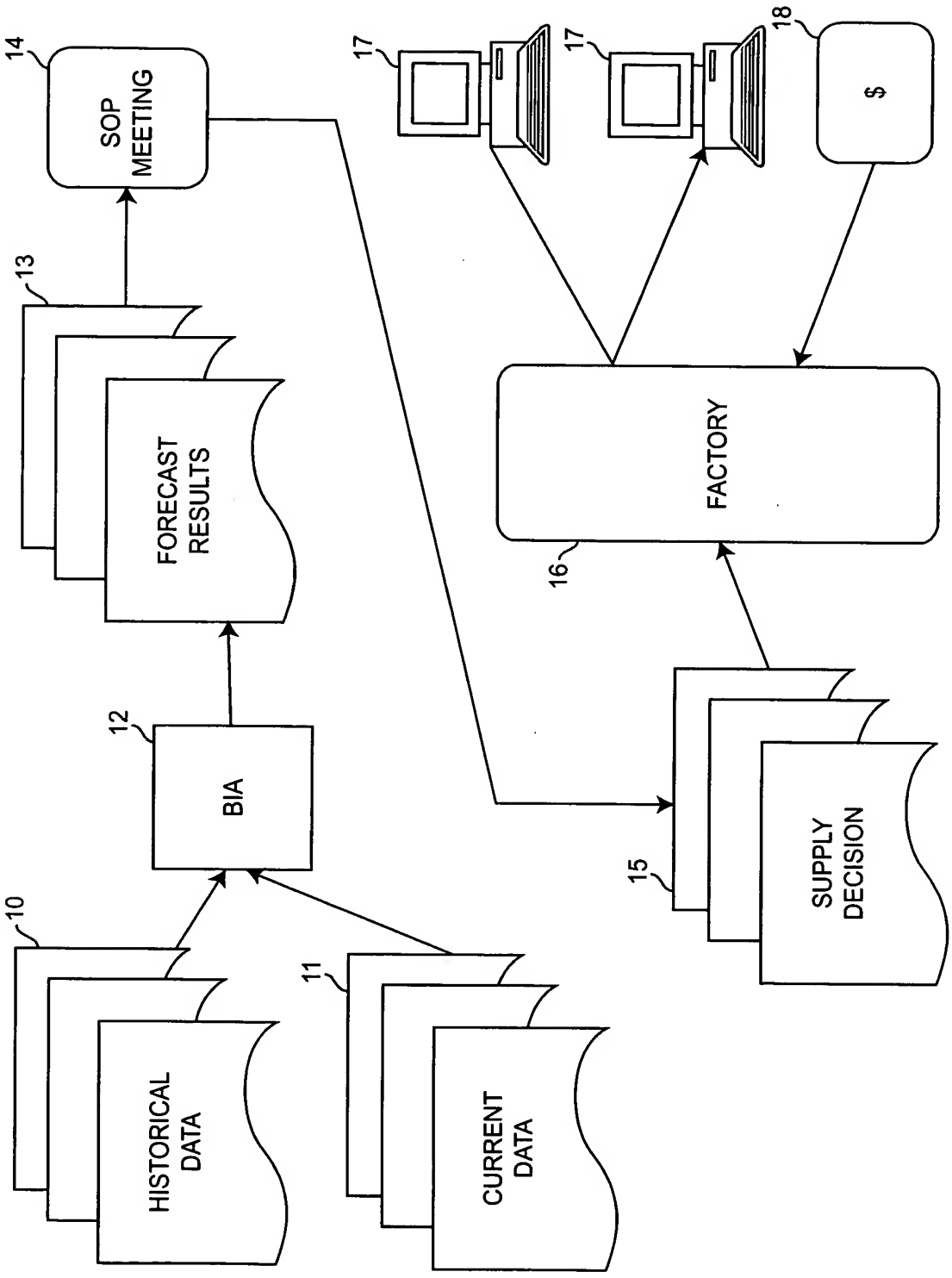

FIGURE 1

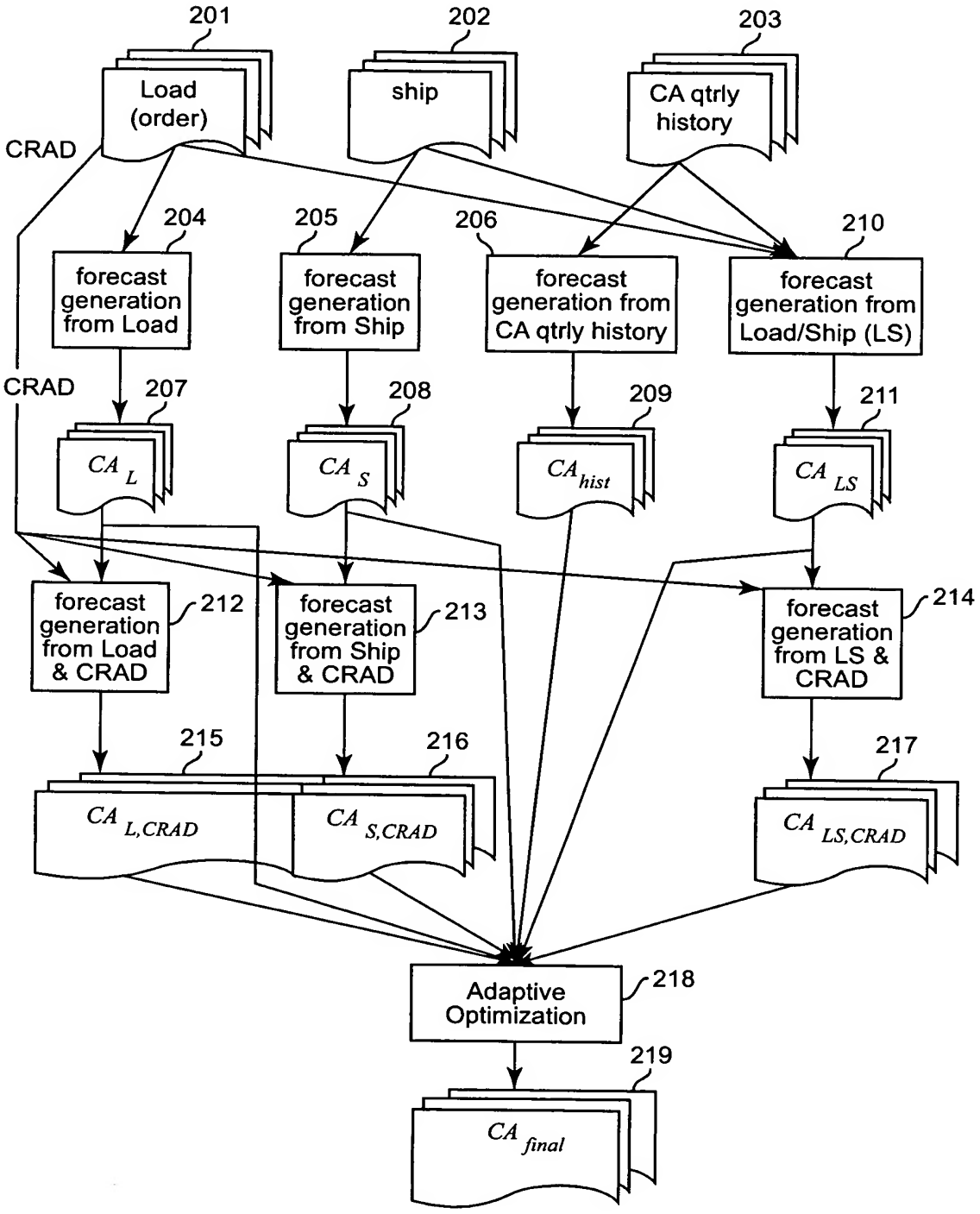
201
Load (order)
202
ship
203
CA qtrly history
CRAD
204
forecast generation from Load
205
forecast generation from Ship
206
forecast generation from CA qtrly history
210
forecast generation from Load/Ship (LS)
CRAD
207
CA_L
208
CA_S
209
CA_{hist}
211
CA_{LS}
forecast generation from Load & CRAD
212
forecast generation from Ship & CRAD
213
forecast generation from LS & CRAD
214
215
$CA_{L,CRAD}$
216
$CA_{S,CRAD}$
217
$CA_{LS,CRAD}$
Adaptive Optimization
218
219
CA_{final}

FIGURE 2

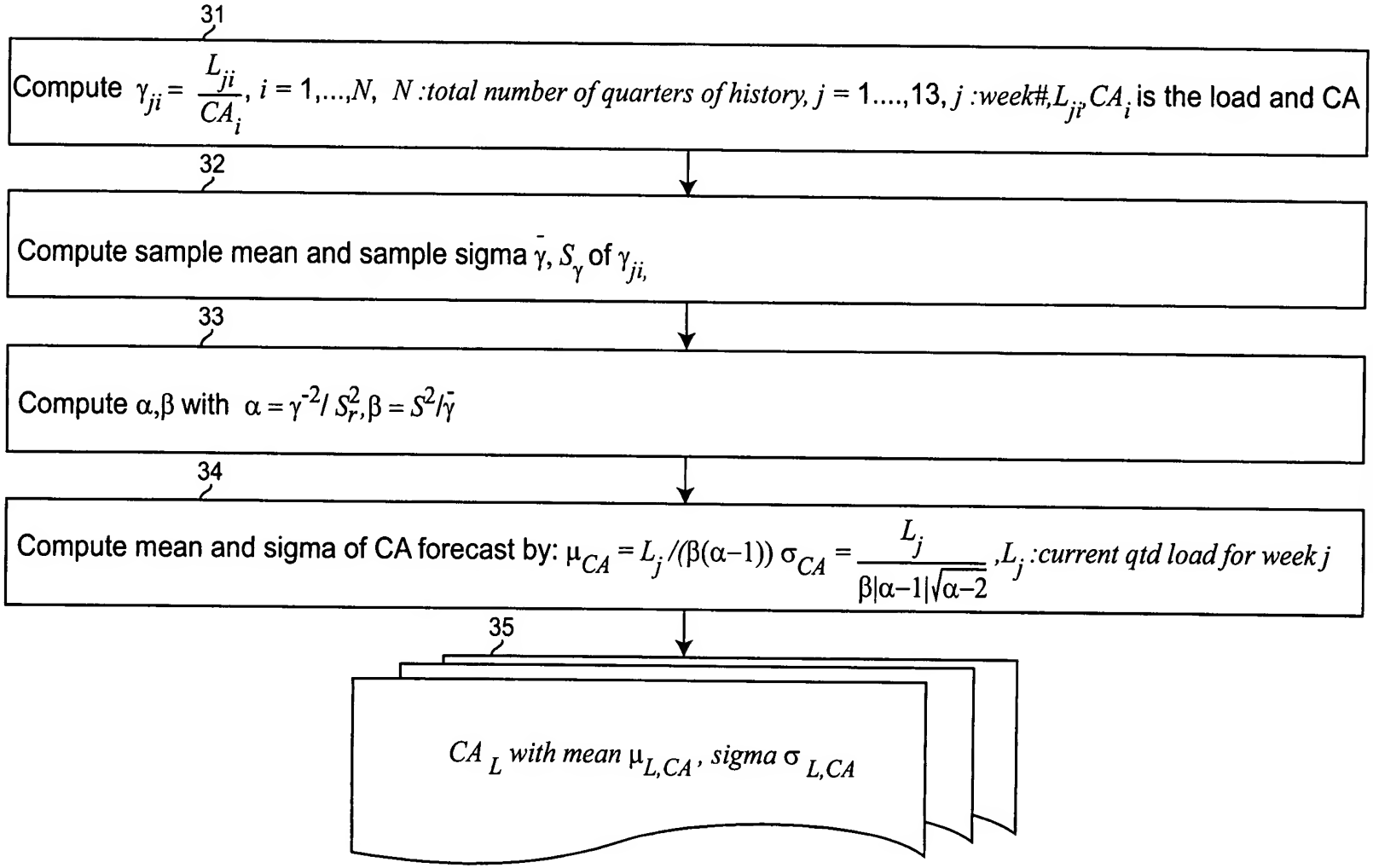
31
Compute $\gamma_{ji} = \frac{L_{ji}}{CA_i}$, $i = 1,...,N$, N :total number of quarters of history, $j = 1....,13$, j :week#, L_{ji}, CA_i is the load and CA
32
Compute sample mean and sample sigma $\bar{\gamma}$, S_γ of γ_{ji},
33
Compute α,β with $\alpha = \gamma^{-2}/S_r^2, \beta = S^2/\bar{\gamma}$
34
Compute mean and sigma of CA forecast by: $\mu_{CA} = L_j/(\beta(\alpha-1))$ $\sigma_{CA} = \frac{L_j}{\beta|\alpha-1|\sqrt{\alpha-2}}$, L_j :current qtd load for week j
35
CA_L with mean $\mu_{L,CA}$, sigma $\sigma_{L,CA}$

FIGURE 3

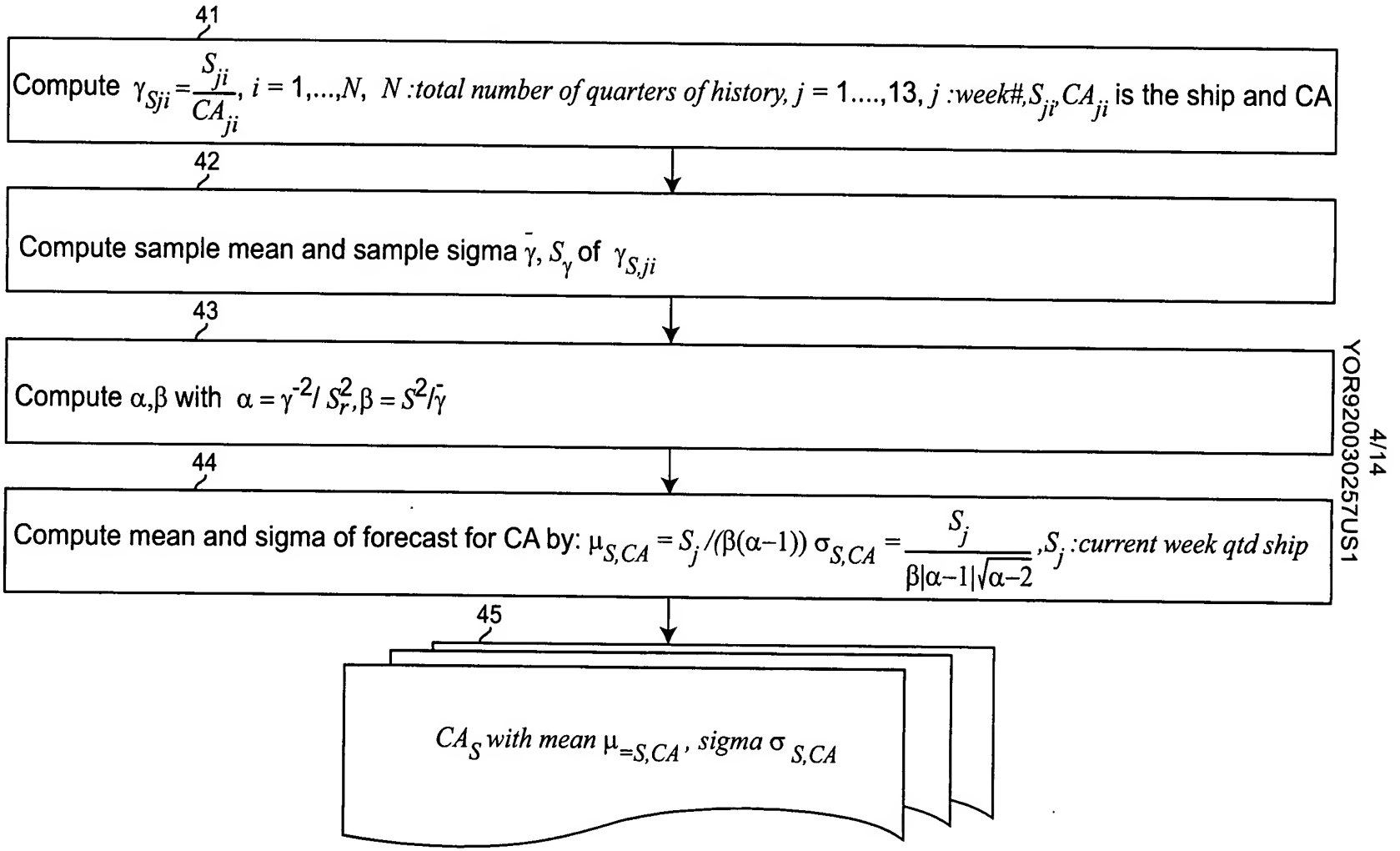
41
Compute $\gamma_{Sji}=\frac{S_{ji}}{CA_{ji}}$, $i = 1,...,N$, N :total number of quarters of history, $j = 1....,13$, j :week#, S_{ji}, CA_{ji} is the ship and CA
42
Compute sample mean and sample sigma $\bar{\gamma}$, S_{γ} of $\gamma_{S,ji}$
43
Compute α,β with $\alpha = \gamma^{-2}/S_{\gamma}^2, \beta = S^2/\bar{\gamma}$
44
Compute mean and sigma of forecast for CA by: $\mu_{S,CA} = S_j/(\beta(\alpha-1))$ $\sigma_{S,CA} = \frac{S_j}{\beta|\alpha-1|\sqrt{\alpha-2}}$, S_j :current week qtd ship
45
CA_S with mean $\mu_{=S,CA}$, sigma $\sigma_{S,CA}$

FIGURE 4

501

Compute $\gamma_{Lji} = \frac{L_{ji}}{CA_{ji}}$, $i = 1,...,N$, N :total number of quarters of history, $N>2$; $j = 1,...,13$, j :week#;L_{ji},CA_j is the load and CA

502

Compute $S_{Lji} = \frac{S_{ji}}{L_{ji}}$, $i = 1,...,N$, N :total number of quarters of history, $j = 1,...,13$, j :week#;L_{ji},S_{ji} is the load and ship

503

Compute $S_{L\gamma,j} = \sum_{i=1}^{N} S_{Lji}\gamma_{Lji}$, $i=1,...,N$, N :total number of quarters of history, $j = 1,...,13$, j :week#;

504

Compute $S_{L\gamma,j} = \sum_{i=1}^{N} S_{Lji}^2\gamma_{Lji}$, $i=1,...,N$, N :total number of quarters of history, $j = 1,...,13$, j :week#;

505

Compute $S_{Lw,j} = \sum_{i=1}^{N} S_{Lji}\, w_{ji}$, $i=1,...,N$, N :total number of quarters of history, $j = 1,...,13$, j :week#;w, is the weight factor

506

Compute $\gamma_{w,j} = \sum_{i-1}^{N} \gamma_{ji} w_{ji}$, $i=1,...,N$, N :total number of quarters of history, $j = 1....,13$, j :week#;w, is the weight factor

507

Compute $W = \sum_{i-1}^{N} w_{ji}$, $i=1,...,N$, N :total number of quarters of history, w, is the weight factor

508

Compute $\alpha = \frac{S_{Lwj}\gamma_{wj} - WS_{L\gamma wj}}{WS_{L^2wj} - S^2_{Lwj}}$, $i=1,...,N$, N :total number of quarters of history

509

Compute $b = \exp\{\frac{\gamma_{wj} + \alpha S_{L\gamma wj}}{W}\}$, $i=1,...,N$, N :total number of quarters of history

510

Compute historical error $\varepsilon_{ji} = CA_i - L_{ji} / bS_{Lji}^{-\alpha}$, $i=1,...,N$, N :total number of quarters of history

A1

FIGURE 5A

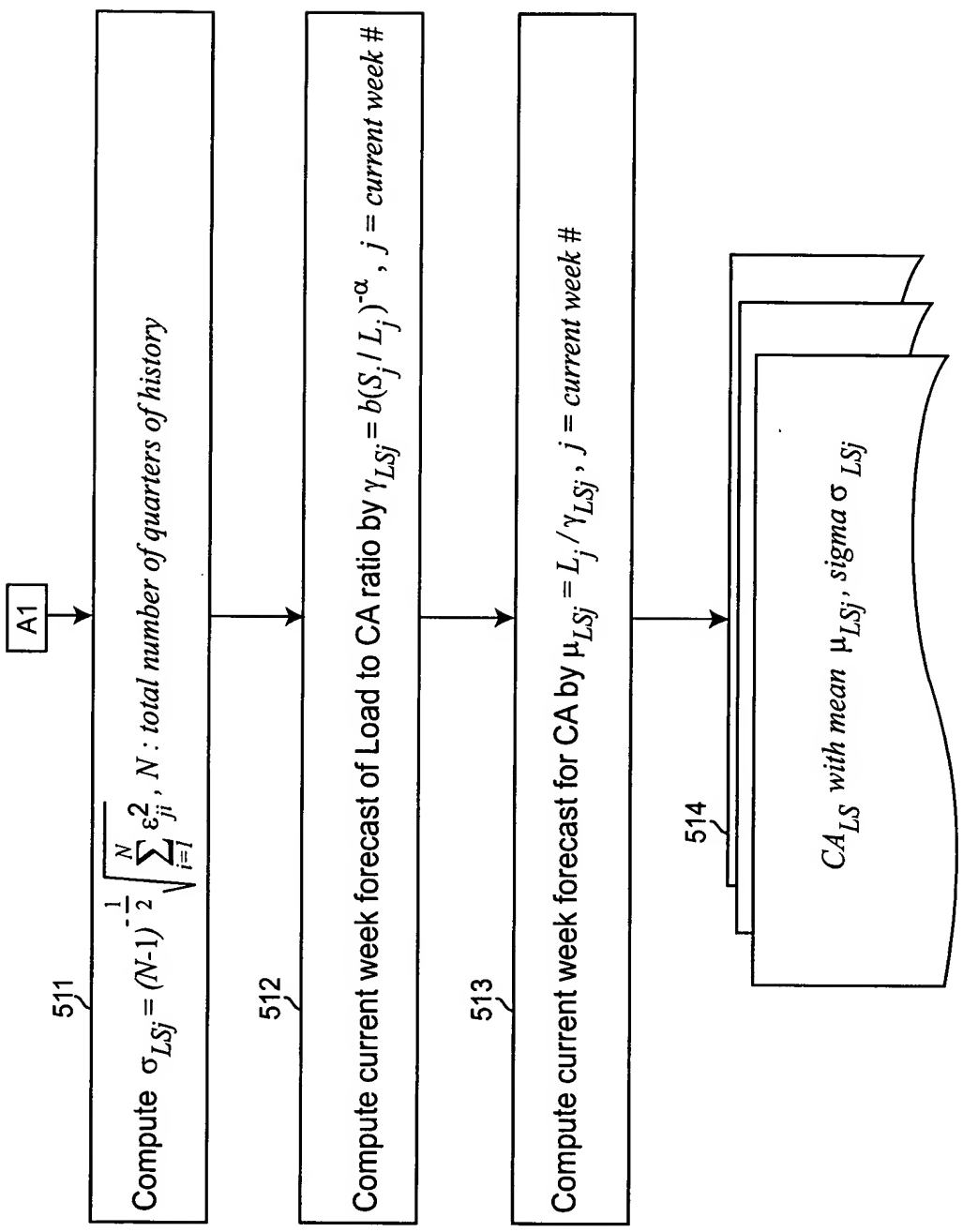
A1
511
Compute $\sigma_{LSj} = (N\text{-}1)^{-\frac{1}{2}} \sqrt{\sum_{i=1}^{N} \varepsilon_{ji}^2}$, N : total number of quarters of history
512
Compute current week forecast of Load to CA ratio by $\gamma_{LSj} = b(S_j / L_j)^{-\alpha}$, j = current week #
513
Compute current week forecast for CA by $\mu_{LSj} = L_j / \gamma_{LSj}$, j = current week #
514
CA_{LS} with mean μ_{LSj}, sigma σ_{LSj}

FIGURE 5B

601

Compute the mean and sigma for the histogram constructed from all the dates for the CRAD for each individual outstanding order book as of any given week in history, and call it μ_{CRADji} *and* σ_{CRADji}, i=1,...,N, N *:total number of quarters of history,* j = 1,...,13, j *:week#;*

602

Compute $SNR_{ji} = \ln \{\frac{\mu_{CRADji}}{\sigma_{CRADji}}\}$, i = 1,...,N, N *:total number of quarters of history,* j = 1,...,13, j *:week#*

603

Compute $\varepsilon_{ji} = CA_{ji}\,\mu_{Lji}$, i=1,...,N, N*:total number of quarters of history,* j = 1,...,13, j*:week#*

604

Compute $\varepsilon_{SNRj} = \sum_{i=1}^{N} \varepsilon_{ji}\, SNR_{ji}$, i=1,...,N, N *:total number of quarters of history,* j = 1,...,13, j *:week#*

605

Compute $\varepsilon_{SNRwj} = \sum_{i=1}^{N} \varepsilon_{ji}\, SNR_{ji} w_i$, i=1,...,N, N *:total number of quarters of history,* j = 1,...,13, j *:week#*

606

Compute $SNR_{wj} = \sum_{i=1}^{N} SNR_{ji} w_i$, i=1,...,N, N *:total number of quarters of history,* j = 1....,13, j *:week#*

607

Compute $\varepsilon_{wj} = \sum_{i=1}^{N} \varepsilon_{ji} w_i$, i=1,...,N, N *:total number of quarters of history,* j = 1....,13, j *:week#*

608

Compute $SNR_{sq,wj} = \sum_{i=1}^{N} SNR_{ji}^2 w_i$, i=1,...,N, N *:total number of quarters of history,* j = 1....,13, j *:week#*

609

Compute $\varepsilon_{sq,wj} = \sum_{i=1}^{N} \varepsilon_{ji}^2 w_i$, i=1,...,N, N *:total number of quarters of history,* j = 1....,13, j *:week#*

R1

FIGURE 6A

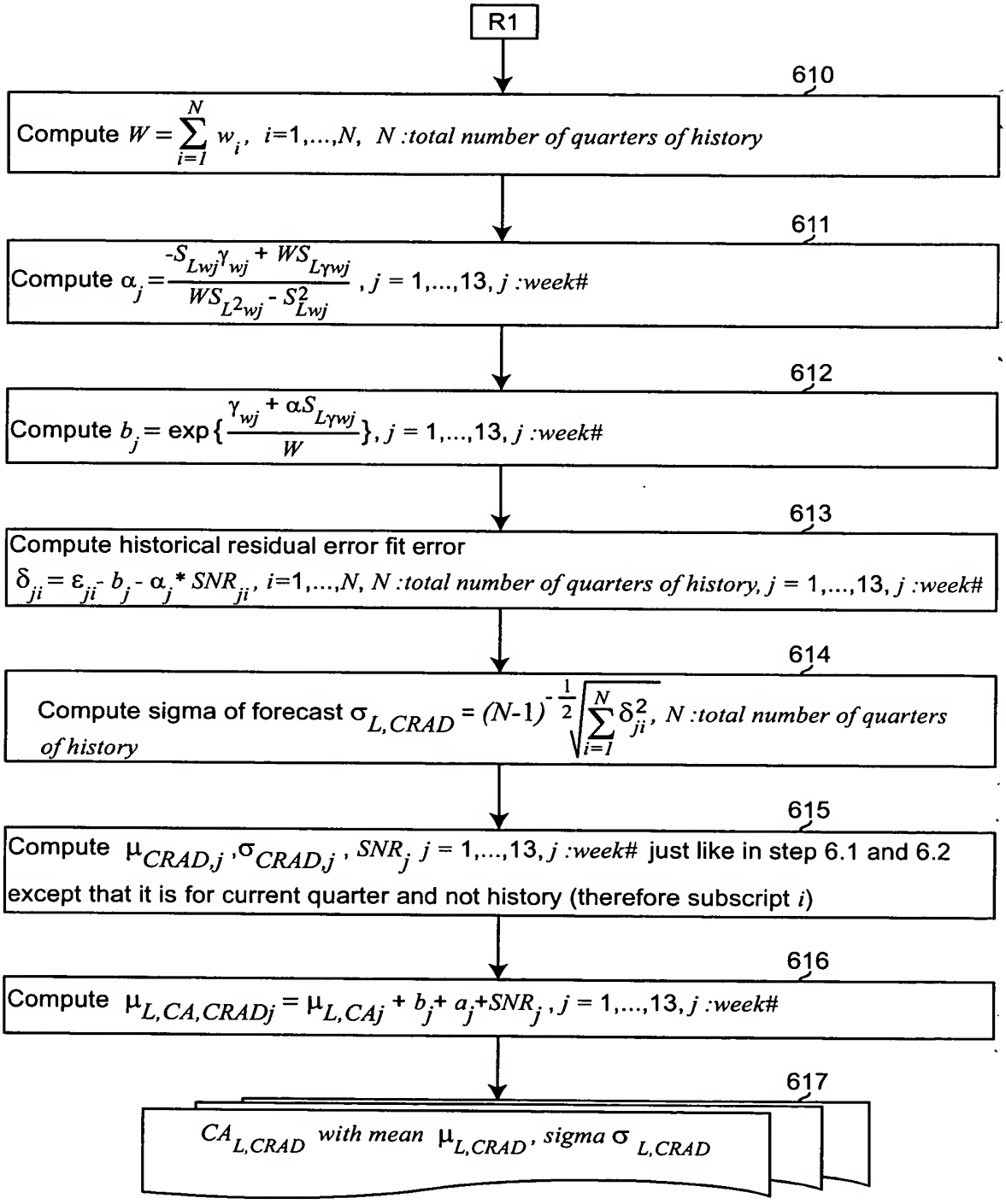
R1
610
Compute $W = \sum_{i=1}^{N} w_i$, i=1,...,N, N :total number of quarters of history
611
Compute $\alpha_j = \frac{-S_{Lwj}\gamma_{wj} + WS_{L\gamma wj}}{WS_{L^2wj} - S^2_{Lwj}}$, j = 1,...,13, j :week#
612
Compute $b_j = \exp\{\frac{\gamma_{wj} + \alpha S_{L\gamma wj}}{W}\}$, j = 1,...,13, j :week#
613
Compute historical residual error fit error
$\delta_{ji} = \varepsilon_{ji} - b_j - \alpha_j * SNR_{ji}$, i=1,...,N, N :total number of quarters of history, j = 1,...,13, j :week#
614
Compute sigma of forecast $\sigma_{L,CRAD} = (N\text{-}1)^{-\frac{1}{2}} \sqrt{\sum_{i=1}^{N} \delta^2_{ji}}$, N :total number of quarters of history
615
Compute $\mu_{CRAD,j}$, $\sigma_{CRAD,j}$, SNR_j j = 1,...,13, j :week# just like in step 6.1 and 6.2 except that it is for current quarter and not history (therefore subscript i)
616
Compute $\mu_{L,CA,CRADj} = \mu_{L,CAj} + b_j + a_j + SNR_j$, j = 1,...,13, j :week#
617
$CA_{L,CRAD}$ with mean $\mu_{L,CRAD}$, sigma $\sigma_{L,CRAD}$

FIGURE 6B

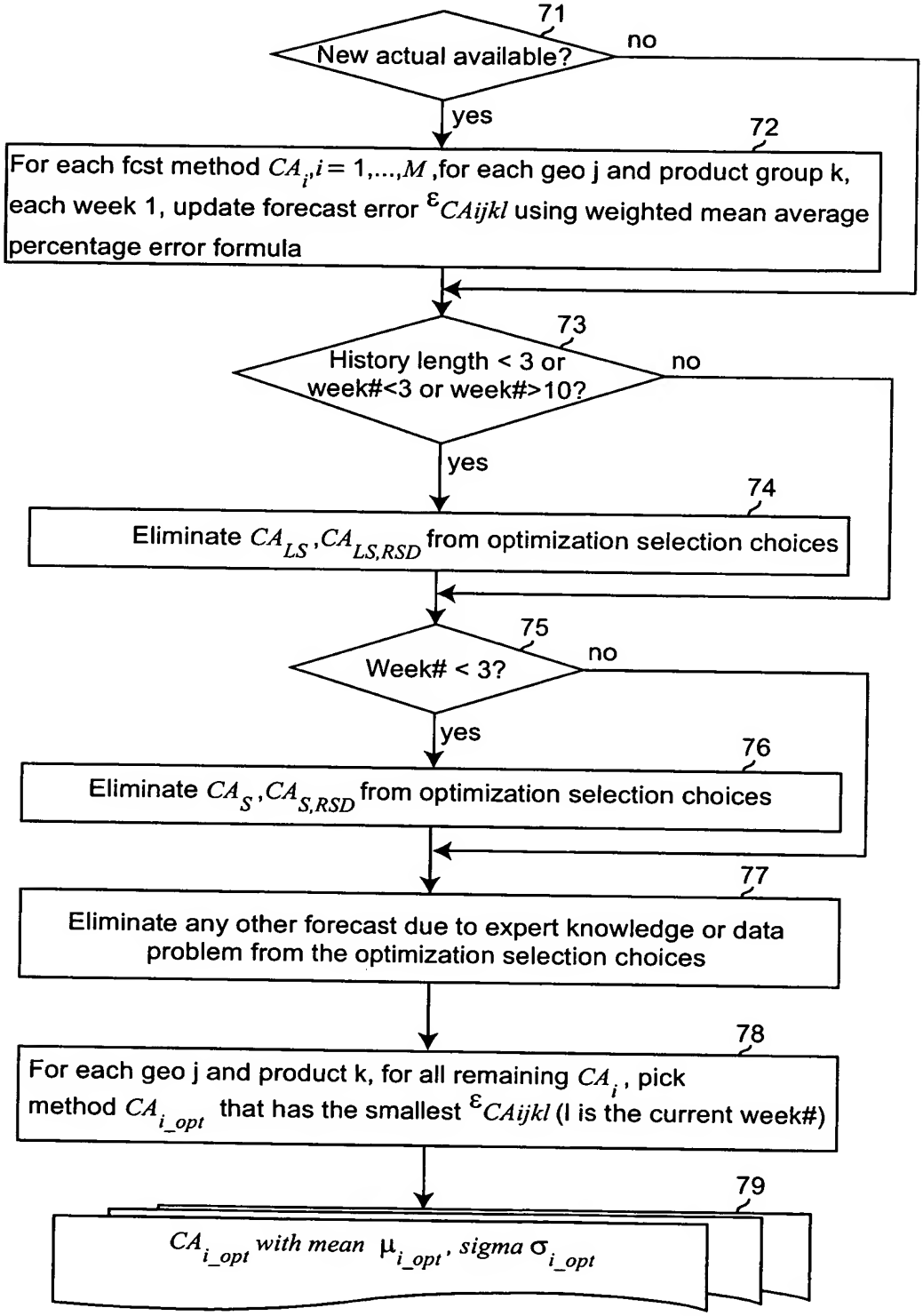
71
New actual available?
no
yes
72
For each fcst method $CA_i, i = 1,...,M$,for each geo j and product group k, each week 1, update forecast error ε_{CAijkl} using weighted mean average percentage error formula
73
History length < 3 or week#<3 or week#>10?
no
yes
74
Eliminate $CA_{LS}, CA_{LS,RSD}$ from optimization selection choices
75
Week# < 3?
no
yes
76
Eliminate $CA_S, CA_{S,RSD}$ from optimization selection choices
77
Eliminate any other forecast due to expert knowledge or data problem from the optimization selection choices
78
For each geo j and product k, for all remaining CA_i, pick method CA_{i_opt} that has the smallest ε_{CAijkl} (l is the current week#)
79
CA_{i_opt} with mean μ_{i_opt}, sigma σ_{i_opt}

FIGURE 7

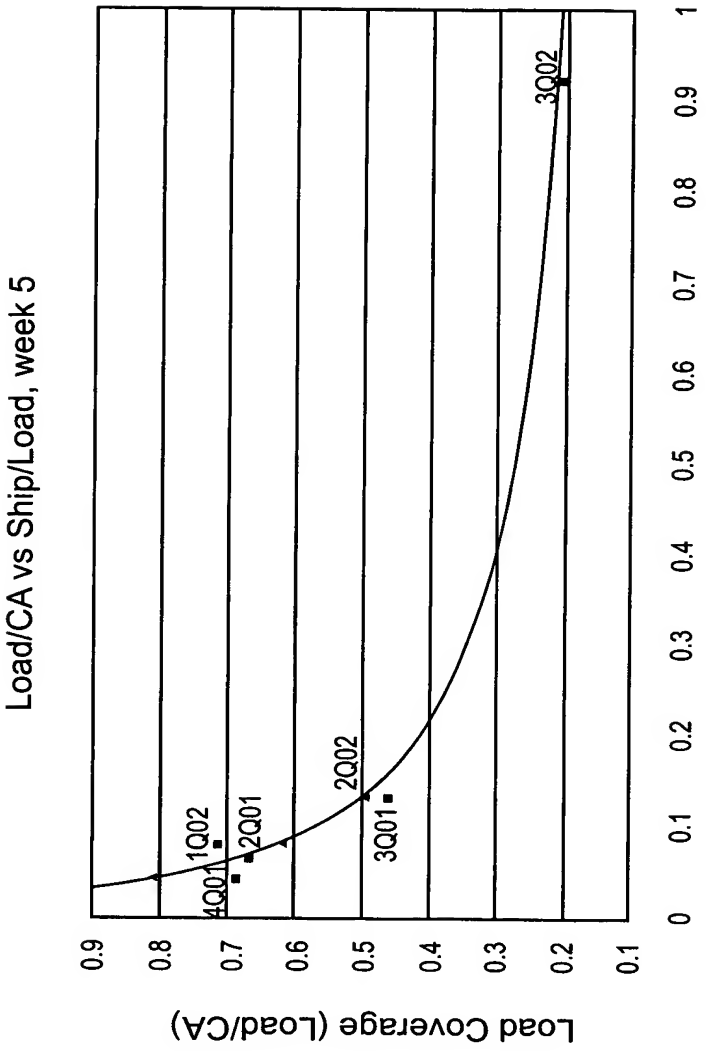
Load/CA vs Ship/Load, week 5
Load Coverage (Load/CA)
Ship/Load
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
4Q01
1Q02
2Q01
2Q02
3Q01
3Q02

FIGURE 8

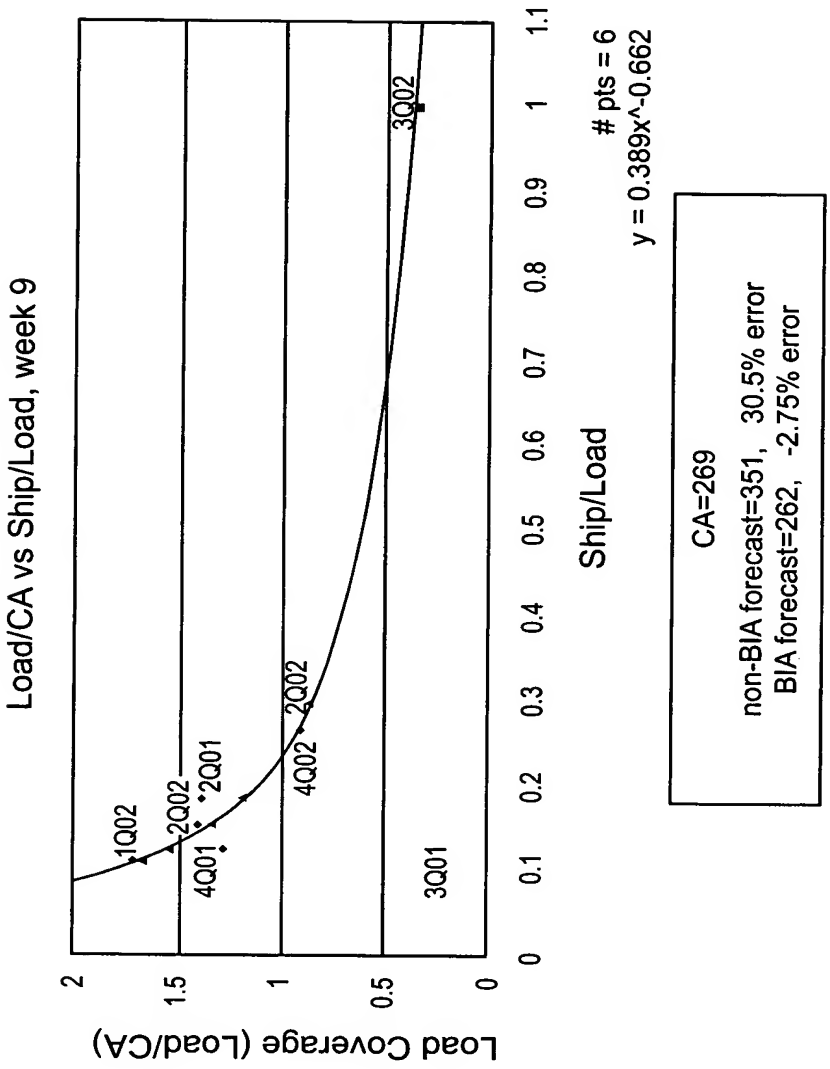
Load/CA vs Ship/Load, week 9
Load Coverage (Load/CA)
Ship/Load
0
0.5
1
1.5
2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1Q02
2Q02
4Q01
2Q01
4Q02
2Q02
3Q02
3Q01
# pts = 6
y = 0.389x^-0.662
CA=269
non-BIA forecast=351, 30.5% error
BIA forecast=262, -2.75% error

FIGURE 9

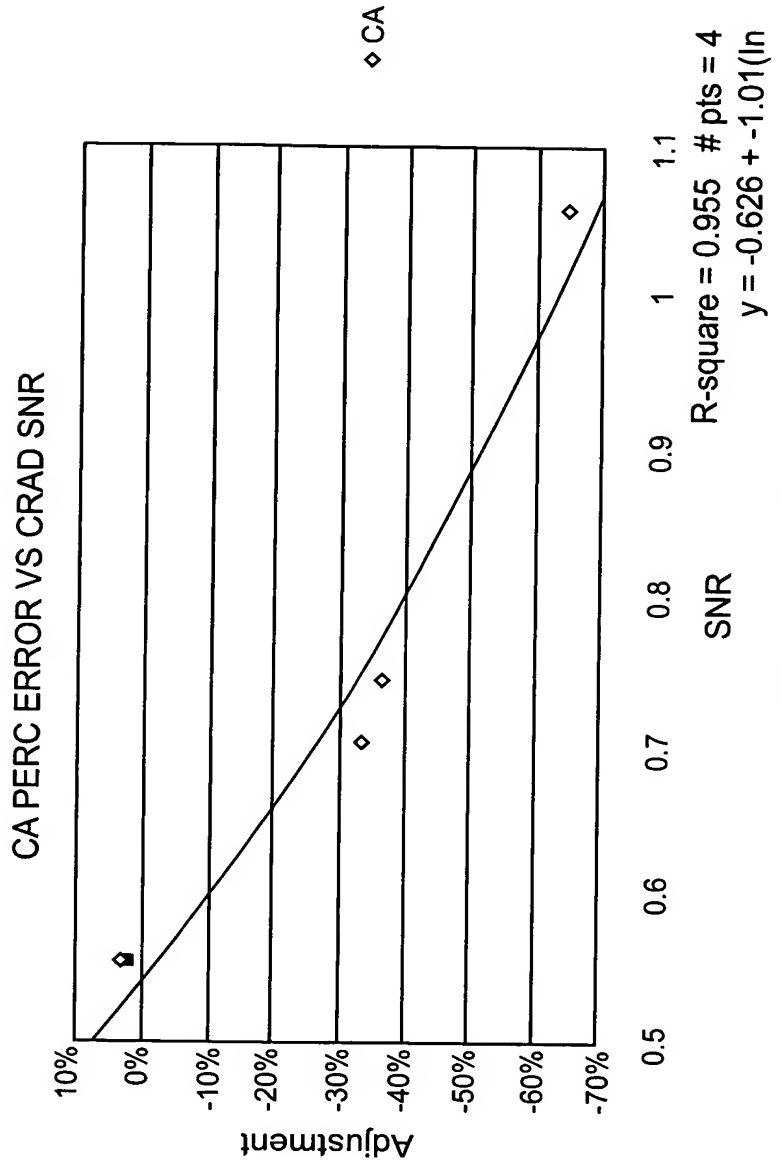
CA PERC ERROR VS CRAD SNR
◇ CA
Adjustment
10%
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
0.5
0.6
0.7
0.8
0.9
1
1.1
SNR
R-square = 0.955 # pts = 4
y = -0.626 + -1.01(ln

FIGURE 10

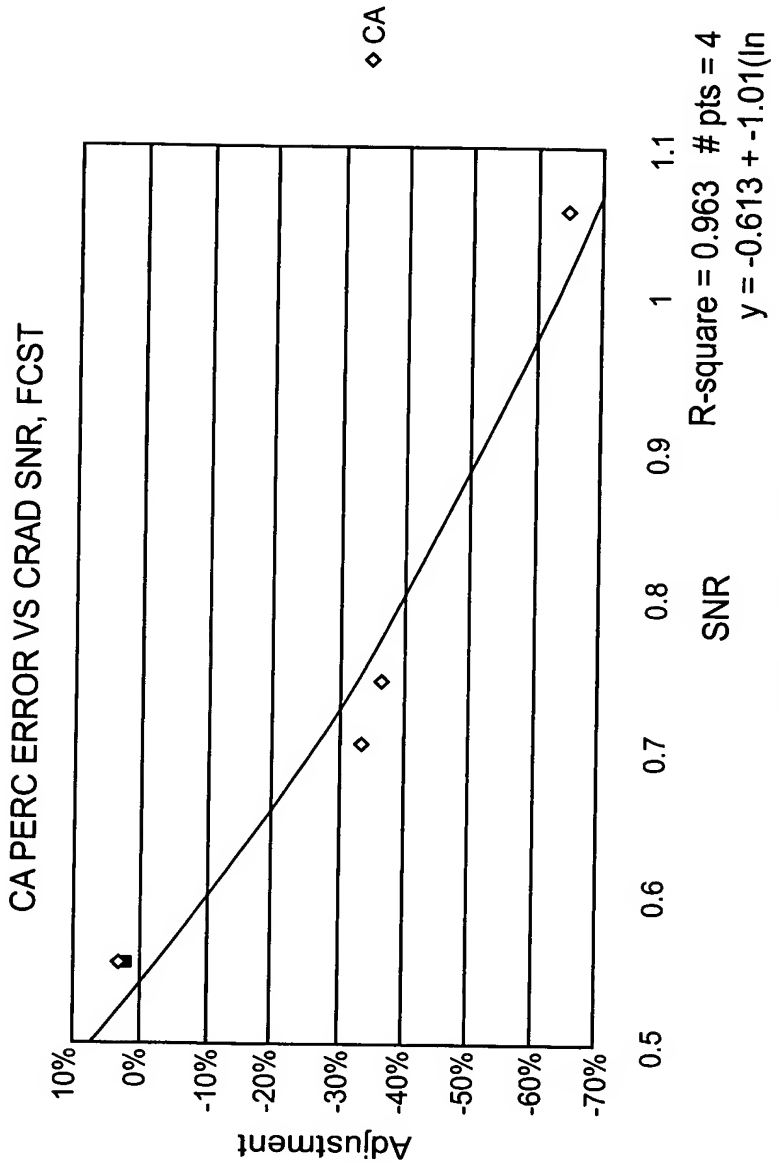
CA PERC ERROR VS CRAD SNR, FCST
◇ CA
Adjustment
10%
0%
-10%
-20%
-30%
-40%
-50%
-60%
-70%
0.5
0.6
0.7
0.8
0.9
1
1.1
SNR
R-square = 0.963 # pts = 4
y = -0.613 + -1.01(ln

FIGURE 11

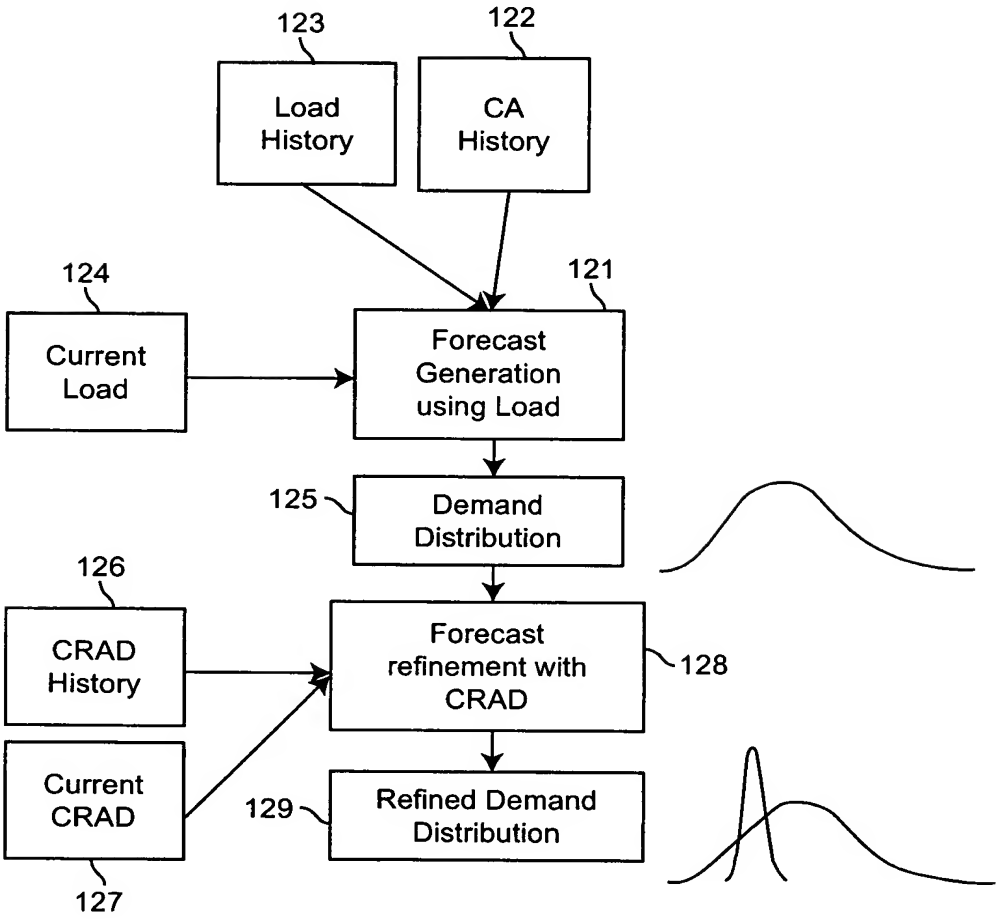
123
122
Load History
CA History
124
121
Current Load
Forecast Generation using Load
125
Demand Distribution
126
CRAD History
Forecast refinement with CRAD
128
Current CRAD
129
Refined Demand Distribution
127

FIGURE 12